

LABORATORY EVALUATION OF PREDATORY CAPABILITIES OF A
COMMON WOLF SPIDER (ARANEAE: LYCOSIDAE) AGAINST TWO
SPECIES OF TICKS (ACARI: IXODIDAE)

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Abstract.—Black-legged ticks, *Ixodes scapularis* Say and adult American dog ticks, *Dermacentor variabilis* (Say) were readily attacked by the wolf spider, *Schizocosa ocreata* (Hentz) in petri dish bioassays. Younger (4–5 mm body length) *S. ocreata* were less successful in their attacks (66.7%) against *I. scapularis* adults than individuals with body lengths of 7–9 mm, which killed 100% of the *I. scapularis* adults. Against adults of *D. variabilis* the attacks of even the larger *S. ocreata* were generally ineffectual, killing only 14.3% of the larger tick. The *S. ocreata* were able to lift the *D. variabilis* from the substrate, but may have been deterred from further attack by defensive secretions known to be produced by the latter.

Key Words: Predation, *Schizocosa ocreata*, *Ixodes scapularis*, *Dermacentor variabilis*, Lycosidae, Ixodidae

Wolf spiders (Lycosidae) constitute a major group of arthropod predators on the forest floor in northern temperate regions (Clark and Grant 1968). Like most spiders they are generalists in their choice of prey and because of their foraging activities on the leaf litter are likely to encounter host-seeking and recently fed ticks. Black-legged ticks, *Ixodes scapularis* Say, and American dog ticks, *Dermacentor variabilis* (Say) are three-host ticks; the former typically a woodland species (Ginsberg and Ewing 1989) and the latter somewhat more of a woods-edge inhabitant at least in the adult stage (Sonenshine and Levy 1972). Larval and nymphal *I. scapularis* and *D. variabilis* seek hosts on the leaf litter (Ginsberg and Ewing 1989, Smith et al. 1946) and, although the adults of both species may quest for hosts as high as 1 m above ground level (Harlan and Foster 1990), they are exposed to wolf spider predation when

moving to, or changing, questing sites. After each engorgement (three for females) both species of tick are vulnerable to attack when they leave their hosts to find molting sites or oviposition sites.

There are few accounts of arthropod predation upon ixodid ticks (e.g. Barre et al. 1991) and even fewer mention spiders. The common theridiid spider *Achaearanea tepidariorum* (C. L. Koch), which often infests buildings, has been observed preying upon the lone star tick, *Amblyomma americanum* (Linnaeus) (Guarisco 1991). In Kenya, Mwangi et al. (1991) reported that (unidentified) spiders killed engorged *Rhipicephalus appendiculatus* Neumann in the laboratory. Wilkinson (1970) found that the wolf spider *Lycosa godeffroyi* Koch preyed upon engorged females of the cattle tick, *Boophilus microplus* (Canestrini), in Australia.

According to Riechert and Lockley (1984) generalist spider predators can make

a significant contribution toward biological control of insect pest species. To determine whether wolf spider predation might have any impact on the populations of two medically important tick species, a series of laboratory feeding bioassays was conducted.

METHODS

Wolf spiders were collected by pitfall traps and in vials by hand in mixed oak-beech woodlands and woods edges in Prince George's County, Maryland. Spider collection sites were habitats where *I. scapularis* and *D. variabilis* occurred. In the laboratory spiders were maintained in petri dishes (5 cm diameter) containing moist tissue paper and were fed larvae of the European corn borer, *Ostrinia nubilalis* (Hubner) (Lepidoptera, Pyralidae). Ticks were collected with a 1-m² flannel drag, and kept in high humidity (99% R.H. for *I. scapularis* and 94% for *D. variabilis*) at 22–26°C and natural photoperiod.

Schizocosa ocreata, the species of wolf spider collected in the greatest numbers, was used in the predation tests. Because an *O. nubilalis* larva constituted a large meal, spiders were tested 4 days after being fed. A single tick was placed in the petri dish with a spider and the initial encounter and activities for the next 5 min were observed. They were checked again after a second 5 min and again at 48 h after the tick was placed in the petri dish to determine tick mortality. As a reference for background tick mortality, ticks were placed in petri dishes containing moist tissue paper and checked at 48 h and 1 wk.

Unfed male and female *I. scapularis* adults, unfed *I. scapularis* nymphs and engorged *I. scapularis* larvae were tested. The engorged nymphs dropped from their laboratory rat hosts <48 h before testing and were still actively crawling when confined with the spiders. Spiders of two size ranges (4–5 mm and 7–9 mm body length) were tested. Only unfed adult female *D. variabilis* (about twice the size of *I. scapularis* females) were tested. Spiders and ticks

Table 1. Proportion of encounters between wolf spiders, *S. ocreata* and ticks, *I. scapularis* and *D. variabilis*, confined together in petri dishes in which the tick was killed.^a

Body Length of <i>S. ocreata</i> (mm)	<i>I. scapularis</i>				<i>D. variabilis</i> Adult Female
	Adults		Unfed Nymph	Fed Larvae	
	Male	Female			
7–9 ^b	1/1	18/18	1/3		2/14
4–5 ^c	5/7	5/8	2/2	26/27	

^a Tick dead within 48 h after introduction in petri dish with spider. Each spider and tick only used in one test.

^b Spiders collected in spring contemporaneously with adult *I. scapularis* and *D. variabilis* and early *I. scapularis* nymphs.

^c Spiders collected in late summer and fall contemporaneously with adult and larval *I. scapularis*.

were tested just once. Success of *S. ocreata* predation against *I. scapularis* versus *D. variabilis* and between size classes of *S. ocreata* against adult *I. scapularis* were analyzed by Student's *t*-test.

RESULTS

Almost all *S. ocreata* (i.e. 46 of 48) attacked the adult ticks (*I. scapularis* and *D. variabilis*) confined with them upon their first encounter. The outcomes of these attacks varied. *I. scapularis* adults were all killed when confined with the larger (7–9 mm body length) *S. ocreata*, whereas 10 of 15 (66.7%) unfed *I. scapularis* adults were killed by the smaller (younger) *S. ocreata* (4–5 mm body length) (Table 1). *S. ocreata* belonging to the smaller size class were significantly less successful in killing female *I. scapularis* than were ($t = 2.762$, $P < 0.02$) the larger spiders. With one exception attacks upon the engorged *I. scapularis* larvae all ended with the tick eaten (Table 1). Unfed *I. scapularis* nymphs were also attacked, but because of their small size they soon found their way into cracks and crevices (e.g. between the petri dish and lid, or in the wad of moist tissue) inaccessible to the spiders. The larger *S. ocreata* had difficulty in killing the unfed *D. variabilis*

(two of 14, 14.3%) females. Although all the larger *S. ocreata* but one were observed attacking significantly fewer ($t = 4.969$, $P < 0.01$) *D. variabilis* females than *I. scapularis* females were killed by *S. ocreata*.

Attacks were occasionally triggered by the tick wandering into the spider, but in most cases the spider apparently detected the tick at distances of 5 to 10 mm, re-oriented itself, approached the tick and pounced upon it. Invariably ticks of both species responded to the attacks by drawing in their legs, appressing them close to their bodies and ceasing movement. Successful attacks usually involved a spider's lifting the tick from the substrate. This gave the spider access to the tick's venter, where there were more opportunities for the spider's fangs to penetrate the tick's intersegmental membranes at the articulations of its legs. The *S. ocreata* were able to lift the *D. variabilis* females from the substrate, but the *D. variabilis* were usually released by the spiders within 10 sec, and the ticks remained motionless for several minutes. *S. ocreata* were observed holding *I. scapularis* adults >30 min after attacking, which suggests that feeding was involved. Also exsuccous remains of fed *I. scapularis* nymphs were found in the petri dishes 24 h after the start of confinement of the nymphs with *S. ocreata*.

DISCUSSION

Multiple host ticks may be most vulnerable to predation by lycosids as well as many other predators just after having completed engorgement and having dropped from their hosts. At this point they are still mobile and would attract the attention of a wolf spider. Furthermore, the tick's recent blood meal would have stretched its opisthosomal integument quite thin, presumably making it more easily bitten through by a spider than in its unfed configuration. This period of vulnerability is relatively brief, perhaps a matter of minutes or hours until the fed tick is ensconced in the leaf litter. Many fed larval *I. scapularis* are thought to

drop off in the nests of their hosts, predominantly white-footed mice, *Peromyscus leucopus*, and therefore safer from lycosids (Mather and Spielman 1986).

The discrepancy between the two size classes of *S. ocreata* in their ability to kill *I. scapularis* adults may be due to several possible factors. One obvious explanation is size related. The larger spiders could be expected to be stronger, have longer fangs and have the capacity to inject more venom into their prey. The problems the *S. ocreata* had with the *D. variabilis* females may have been due to their inability to penetrate the tick's integument. A similar situation was reported for the jumping spider, *Corythalia canosa* Hentz (Salticidae), a specialist predator of ants (Edwards et al. 1974). *C. canosa* were unable to kill the heavily sclerotized ants *Trachymyrmex septentrionalis* (McCook) and *Cyphomyrmex minutus* Rower, which like ticks pull in their legs and remain motionless when attacked.

A different, or additional, explanation may account for the low success rate (two of 14, 14.3%) of *S. ocreata* against the American dog ticks they attacked. Yoder et al. (1993) found that *D. variabilis* adults produced a waxy secretion on their dorsal surfaces when attacked by ants, or were otherwise similarly disturbed. The secretions caused the ants to cease their attacks, thereby protecting the ticks, a scenario reminiscent of the attacks by *S. ocreata* on *D. variabilis*.

S. ocreata is common throughout woodlands in the eastern United States (Dondale and Redner 1978, Stratton 1991), and was abundant in habitats where both species of tick occurred. In view of the relatively low abundance of ticks compared to other potential prey of *S. ocreata*, it is unlikely that a wolf spider such as *S. ocreata* will encounter successive ticks before finding another meal. Therefore, tests were not conducted to determine the maximum number of ticks an *S. ocreata* is capable of eating. Further evaluation of the impact of *S. ocreata* and other common wolf spiders on

I. scapularis populations is warranted. Also spiders, such as crab spiders (Thomisidae), that frequent adult *I. scapularis* questing sites on vegetation up to 1 m high should be considered as potentially important predators of black-legged ticks.

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